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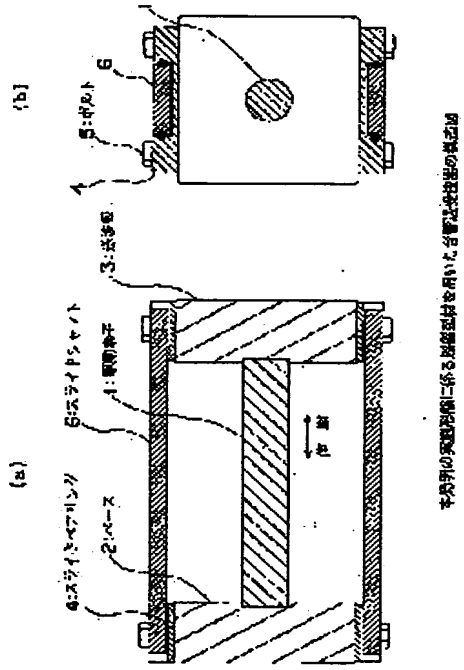
(54) ACOUSTIC TRANSMITTER/RECEIVER USING ULTRA- MAGNETOSTRICTIVE MATERIAL AND METHOD FOR MANUFACTURING THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an acoustic transmitter/receiver using ultra-magnetostrictive materials capable of preventing ultra-magnetostrictive materials from being broken even when any outer force leading to the bending of a driving element made of bar-shaped ultra-magnetostrictive materials is applied, and preventing the performance of a transmitter/receiver from being deteriorated.
SOLUTION: One edge of a driving element 1 is adhered and fixed to the central part of a base 2, and the other edge is adhered and fixed to the central part of a transmitting plate 3, and slide bearings 4 are respectively fixed to the upper edge face and lower edge face of the base 2 and the upper edge face and lower edge face of the transmitting plate 3, and slide shafts 6 are respectively arranged so as to be slide engaged between the respective slide bearings of the base 2 and the respective slide bearings of the transmitting plate 3 so that the sliding axes of the respective slide shafts can be made in parallel.



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CLAIMS

[Claim(s)]
[Claim 1] In the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted A slide bearing is fixed to each location of at least two places corresponding to ** of the adhesion fixed side of said tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. The slide shaft which carries out sliding engagement of between each slide bearing fixed to said tabular base and each slide bearing fixed to the response location of a wave transmission plate is prepared, respectively. The sound transducer using the giant magnetostrictive material characterized by constituting so that the sliding shaft of each of this slide shaft may become in parallel with **.
[Claim 2] In the manufacture approach of the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted Where one pair of slide bearings prepare for one slide shaft beforehand at least two sliding devices which carry out sliding engagement with the same sliding shaft and the adhesion fixed side of said tabular base and the adhesion fixed side of a wave transmission plate are contacted One side and another side of one pair of slide bearings of said each sliding device are fixed to each location of at least two places corresponding to ** of the adhesion fixed side of the tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. Next, the manufacture approach of the sound transducer using the giant magnetostrictive material characterized by extending spacing of the tabular base and a wave transmission plate, carrying out the end of said driver element in the core of the tabular base, and carrying out adhesion immobilization of the other end in the core of a wave transmission plate, respectively, checking sliding actuation of each of said sliding device.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the sound transducer which uses giant magnetostrictive material as a driver element, and its manufacture approach.
[0002]
[Description of the Prior Art] For example, with the transceiver vessel of an underwater acoustic wave, as a sound-source ingredient, although the piezo-electric ceramic etc. was used conventionally, by recent years, giant magnetostrictive ingredients, such as a rare earth alloy which carries out telescopic motion softer [than a piezo-electric ceramic] and big, came to be used. Although it was strong to compression, since [it is told to bending and hauling that is weak] it has the frangible characteristic comparatively, when using this ingredient as a driver element which transmits and receives an acoustic wave, the structure which established structure which bending stress does not generate in a supermagnetostrictor, for example, a guide etc., was required for this giant magnetostrictive ingredient.
[0003] Drawing 3 is structural drawing of the echo sounder transmitter which uses the conventional giant magnetostrictive material as a driver element, (a) of drawing is a side-face sectional view, and (b) is a transverse-plane sectional view. In drawing 3 , 1 is the driver element of the round bar configuration which becomes by giant magnetostrictive material, the end of the shape of the rod is carried out in the core of the base 11, and adhesion immobilization of the other end is carried out in the core of the wave transmission plate 12, respectively. The base 11 and the wave transmission plate 12 are disk types-like, respectively, and they are inserted in the periphery at intervals of an equal include angle, respectively so that four bearings 13 in which lubricant was formed on the front face may surround a driver element 1. And in each four bearing 13 of the base 11, and each four bearing 13 in the response location of the wave transmission plate 12, the whole is constituted through a shaft 14, respectively.
[0004] With the echo sounder transmitter constituted like drawing 3 , if excited with the solenoid coil (for example, prepared so that the surroundings of the round bar-like driver element 1 may be surrounded) with which a driver element 1 is not illustrated, since a driver element 1 is expanded and contracted in the die-length direction of a round bar configuration, if it is fixed to the container with which the location of the base 11 is not illustrated, the wave transmission plate 12 will drive by said flexible motion, and it will operate as an echo sounder transmitter.
[0005]
[Problem(s) to be Solved by the Invention] However, there were the following problems with the structure of the echo sounder transmitter which uses as a driver element the conventional giant magnetostrictive material shown in drawing 3 .
(1) It is necessary to hold fixed path clearance (spacing) between each bearing and a shaft so that smooth telescopic motion of the driver element which becomes by giant magnetostrictive material may not be checked.
(2) It there need to be four shafts in ** in a parallel location and the parallel location of these four shafts shifts, as for a driver element, along with a shaft, a smooth motion becomes impossible. Therefore, the component part needed doubling processing and precision processing, and they had become cost high.
(3) For example, when the path clearance between a bearing and a shaft was too large the carrier beam case in external force which bends a rod-like driver element with water pressure etc., before bearing received impression external force, a possibility that a driver element might fracture by strain was.
[0006]
[Means for Solving the Problem] The sound transducer using the giant magnetostrictive ingredient

concerning this invention In the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted A slide bearing is fixed to each location of at least two places corresponding to ** of the adhesion fixed side of said tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. The slide shaft which carries out sliding engagement of between each slide bearing fixed to said tabular base and each slide bearing fixed to the response location of a wave transmission plate is prepared, respectively, and it constitutes so that the sliding shaft of each of this slide shaft may become in parallel with **.

[0007] The manufacture approach of the sound handset using the giant magnetostrictive material concerning this invention In the manufacture approach of the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted Where one pair of slide bearings prepare for one slide shaft beforehand at least two sliding devices which carry out sliding engagement with the same sliding shaft and the adhesion fixed side of said tabular base and the adhesion fixed side of a wave transmission plate are contacted One side and another side of one pair of slide bearings of said each sliding device are fixed to each location of at least two places corresponding to ** of the adhesion fixed side of the tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. Next, checking sliding actuation of each of said sliding device, spacing of the tabular base and a wave transmission plate is extended, the end of said driver element is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively.

[0008]

[Embodiment of the Invention] Drawing 1 is structural drawing of the sound transducer using the giant magnetostrictive material concerning the operation gestalt of this invention, and (a) of drawing is a side-face sectional view and (b) transverse-plane sectional view. In drawing 1 , 1 is the driver element of the round bar configuration which becomes by giant magnetostrictive material, such as a rare earth alloy, the end of the shape of the rod is carried out in the core of the base 2, and adhesion immobilization of the other end is carried out in the core of the transmission-and-reception plate 3, respectively. The base 2 and the wave transmission plate 3 are the configurations of a rectangular plate here, respectively, and a slide bearing 4 is fixed to the adhesion fixed side, the right-angled upside end face, and bottom end face of said driver element 1 with the mounting eclipse bolt 5, respectively.

[0009] And the slide shaft 6 which carries out sliding engagement of between each slide bearing 4 fixed to the upside end face and bottom end face to which each slide bearing 4 fixed to the upside end face and bottom end face of the base 2, respectively and the wave transmission plate 3 correspond, respectively is constituted so that anchoring and these two sliding shafts of each slide shaft 6 may become in parallel with **, respectively. In addition, even if the sliding device which consists of a slide shaft 6 and one pair of slide bearings 4 receives external force which bends the slide shaft 6, the amount of strains to generate uses an ingredient and structure which are very small.

[0010] With the sound transducer constituted like drawing 1 , if excited with the solenoid coil (for example, prepared so that the surroundings of the round bar-like driver element 1 may be surrounded) with which a driver element 1 is not illustrated, since a driver element 1 is expanded and contracted in the die-length direction of a round bar configuration, if it is fixed to the container with which the location of the base 2 is not illustrated, the wave transmission plate 3 will drive by said flexible motion, and it will operate as an echo sounder transmitter. Moreover, a driver element 1 expands and contracts, and if the wave transmission plate 3 vibrates by the input acoustic wave from the outside, as an echo sounder receiver, induced voltage will be generated in the sensing coil (for example, prepared so that the surroundings of the round bar-like driver element 1 may be surrounded) which is not illustrated, and it will operate as an echo sounder receiver.

[0011] When using the sound transducer of drawing 1 as for example, an underwater sound source, the base 2 and the wave transmission plate 3 may receive external force which bends the rod-like driver element 1 with water pressure etc. In this case, external force is transmitted to the driver element 1 currently first fixed to the base 2 and the wave transmission plate 3 directly, then, is transmitted to one pair of slide shafts 6 which are carrying out sliding engagement at the slide bearing 4, and produces a strain, respectively. Although a driver element 1 begins to bend according to transfer external force first, before resulting in

fracture, the following slide shaft 6 receives transfer external force. However, since the amount of generating strains of the slide shaft 6 is small, more than a constant rate does not turn at and fracture a driver element 1.

[0012] Since it considered as the structure of preventing the bending external force to the driver element to which one pair of slide bearings [2 sets of] become one slide shaft from the giant magnetostrictive material of a cylindrical configuration using the sliding device which carries out sliding engagement with the same sliding shaft, as mentioned above according to the transducer of this operation gestalt, there is the following effectiveness.

(1) Since a slide shaft receives external force before reaching rupture stress even if a supermagnetostrictor receives bending external force, don't fracture a supermagnetostrictor.

(2) In order that a sliding device may move smoothly, the engine performance as an echo sounder transmitter does not fall in the wave transmission direction of a wave transmission plate. Moreover, it operates, without carrying out degradation as an echo sounder receiver similarly.

[0013] Drawing 2 is the explanatory view of the manufacture approach of the sound transducer of drawing 1 , and manufactures in order of (a) of drawing, (b), and (c). Moreover, a side-face sectional view and right-hand side drawing of the chart on the left of (a) - (c) of drawing are transverse-plane sectional views. Precision processing of the base 2 and the wave transmission plate 3 is carried out beforehand. Especially the base 2 and an echo sounder transmitter 3 process the squareness of this adhesion datum plane, a right-angled upside end face, and a bottom end face, i.e., the clamp face of a slide bearing 4, into a precision on the basis of an adhesion side with a driver element 1. Moreover, the path clearance between a slide bearing 4 and the slide shaft 6 (spacing) processes about 0.01mm.

[0014] The manufacture procedure prepares for one slide shaft 6 beforehand 2 sets of sliding devices in which one pair of slide bearings 4 carry out sliding engagement with the same sliding shaft. And first, as shown in (a) of drawing 2 , it checks that fix to the end face (slide bearing clamp face) of a base 2 upside and the bottom, and the end face (slide bearing clamp face) of the wave transmission plate 3 upside and the bottom said one side and another side of one pair of slide bearings 4 of each sliding device which were prepared with a bolt 5, respectively, and the slide shaft 6 moves smoothly where the adhesion side side of the base 2 and the driver element 1 of the wave transmission plate 3 is contacted.

[0015] Next, checking sliding actuation of each of said sliding device, as shown in (b) of drawing 2 , spacing of the base 2 and the wave transmission plate 3 is extended to extent which can paste up a driver element 1, the end of the cylindrical driver element 1 is pasted up on the adhesion side of the base 2, and the other end is pasted up on the adhesion side of the wave transmission plate 3, respectively (see the (c) of drawing 2).

[0016] As mentioned above, preparing for one slide shaft beforehand at least 2 sets of sliding devices in which sliding engagement of one pair of slide bearings was carried out, and checking the parallelism of an adhesion side with the driver element of the base and a wave transmission plate, and smooth sliding actuation of a sliding device, according to the manufacture approach of the transducer of this operation gestalt, by that of ********, the hand return like an erector can be prevented and manufacture effectiveness can be raised.

[0017] In addition, although this operation gestalt showed the example using the sliding device in which sliding engagement of one pair of slide bearings was carried out to one slide shaft 2 sets, this invention is not limited to these 2 sets, and is used 4 sets, for example, you may make it attach a slide bearing in each end face of the base 2 of drawing 1 , and the four directions of the wave transmission plate 3, respectively.

[0018]

[Effect of the Invention] In the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material as mentioned above according to this invention is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted A slide bearing is fixed to each location of at least two places corresponding to ** of the adhesion fixed side of said tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. The slide shaft which carries out sliding engagement of between each slide bearing fixed to said tabular base and each slide bearing fixed to the response location of a wave transmission plate is prepared, respectively. Since a slide shaft receives external force before reaching rupture stress even if the driver element which consists of giant magnetostrictive material receives bending external force, since it constituted so that the sliding shaft of each of this slide shaft might become in parallel with **, a driver element does not fracture. Moreover, the engine performance of a transducer is not reduced by the above-mentioned configuration.

[0019] Moreover, it sets to the manufacture approach of the sound transducer which the end of the driver element which consists of giant magnetostrictive rod-like material as mentioned above according to this invention is carried out in the core of the tabular base, and adhesion immobilization of the other end is carried out in the core of a wave transmission plate, respectively, and is constituted. Where one pair of slide bearings prepare for one slide shaft beforehand at least two sliding devices which carry out sliding engagement with the same sliding shaft and the adhesion fixed side of said tabular base and the adhesion fixed side of a wave transmission plate are contacted One side and another side of one pair of slide bearings of said each sliding device are fixed to each location of at least two places corresponding to ** of the adhesion fixed side of the tabular base, a right-angled end face and the adhesion fixed side of a wave transmission plate, and a right-angled end face, respectively. Next, since spacing of the tabular base and a wave transmission plate was extended, and the end of said driver element was carried out in the core of the tabular base and it was made to carry out adhesion immobilization of the other end in the core of a wave transmission plate, respectively, checking sliding actuation of each of said sliding device, the hand return like an erector can be prevented and manufacture effectiveness can be improved.

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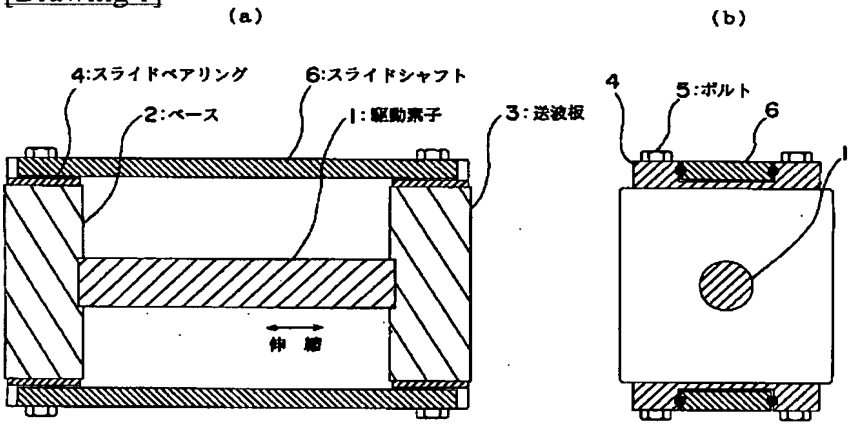
DRAWINGS

[Drawing 1]



本発明の実施形態に係る超磁歪材を用いた音響送受波器の構造図

[Drawing 2]

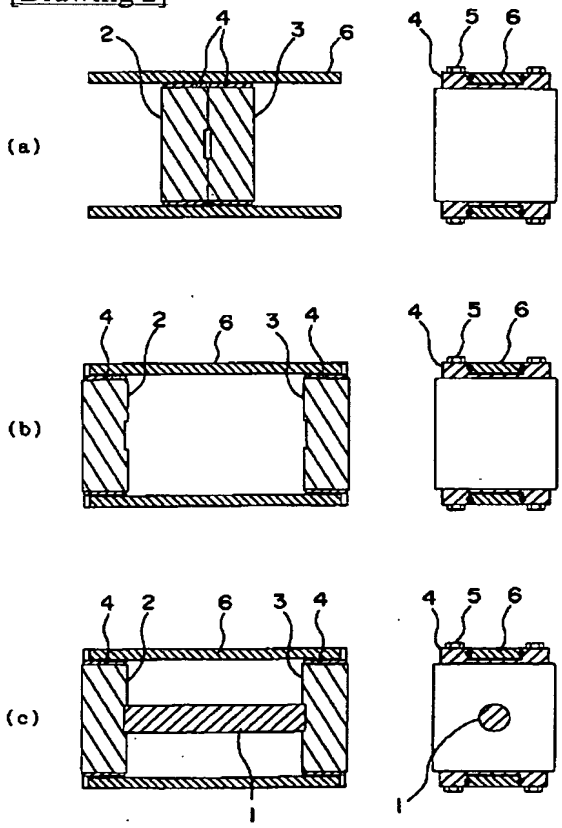
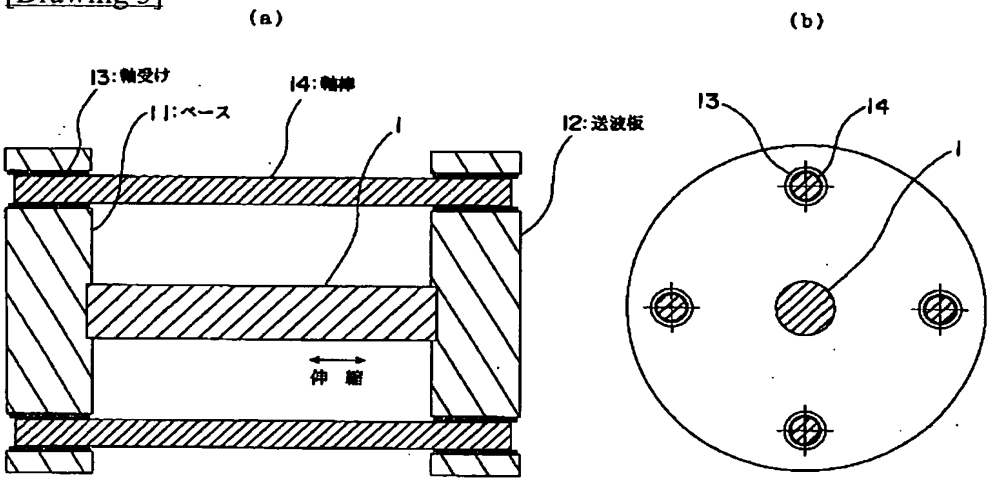


図1の音響送受波器の製造方法の説明図

[Drawing 3]



従来の超磁歪材を駆動素子とする送波器の構造例を示す図

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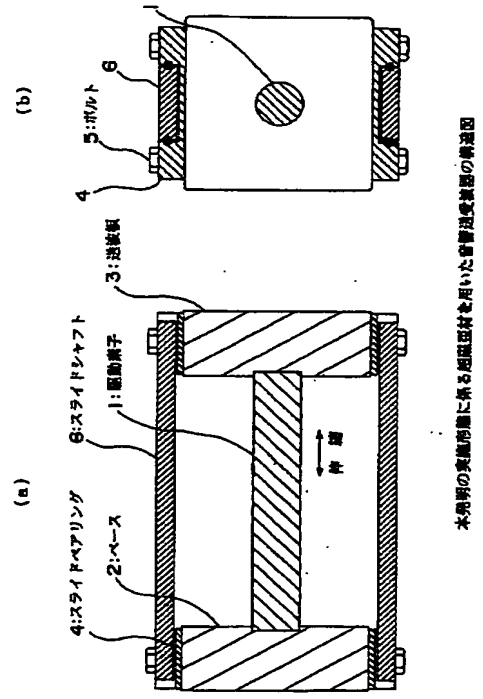
最終頁に続く

(54)【発明の名称】　超磁歪材を用いた音響送受波器及びその製造方法

(57)【要約】
【課題】　棒状の超磁歪材よりなる駆動素子を曲げるような外力を受けた場合にも、超磁歪材は破断せず、送受波器の性能も低下させない超磁歪材を用いた音響送受波器。
【解決手段】　駆動素子１の一端はベース２の中心部に、他端は送波板３の中心部にそれぞれ接着固定し、ベース２の上側端面と下側端面及び送波板３の上側端面と下側端面にそれぞれスライドベアリング４を固定し、ベース２の各スライドベアリングと送波板３の各スライドベアリングの間を摺動係合するスライドシャフト６をそれぞれ設け、各スライドシャフトの摺動軸が互に平行になるように構成した。



【特許請求の範囲】

【請求項１】　棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器において、前記板状ベースの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置にスライドベアリングをそれぞれ固定し、前記板状ベースに固定された各スライドベアリングと送波板の対応位置に固定された各スライドベアリングの間を摺動係合するスライドシャフトをそれぞれ設け、該各スライドシャフトの摺動軸が互に平行になるように構成したことを特徴とする超磁歪材を用いた音響送受波器。

【請求項２】　棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器の製造方法において、

予め１本のスライドシャフトに１対のスライドベアリングが同一摺動軸で摺動係合する摺動機構を少くとも２個用意しておき、前記板状ベースの接着固定面と送波板の接着固定面とを接触させた状態で、板状ベースの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置に前記各摺動機構の１対のスライドベアリングの一方と他方をそれぞれ固定し、次に前記各摺動機構の摺動動作を確認しながら板状ベースと送波板の間隔を広げて前記駆動素子の一端を板状ベースの中心部に、他端を送波板の中心部にそれぞれ接着固定することを特徴とする超磁歪材を用いた音響送受波器の製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、超磁歪材を駆動素子とする音響送受波器とその製造方法に関するものである。

【０００２】

【従来の技術】例えば、水中音波の送受信器では、音源材料として、従来は圧電セラミック等が使用されていたが、近年では圧電セラミックよりもやわらかくて大きな伸縮をする希土類合金等の超磁歪材料が用いられるようになった。この超磁歪材料は、圧縮には強いが、曲げや引っ張りには弱いという、比較的もろい性質を有しているため、この材料を音波を送受信する駆動素子として使用する場合には、超磁歪素子に曲げ応力が発生しないような構造、例えばガイド等を設けた構造等が必要であった。

【０００３】図３は、従来の超磁歪材を駆動素子とする送波器の構造図であり、図の（ａ）は側面断面図、（ｂ）は正面断面図である。図３においては、１は超磁歪材によりなる丸棒形状の駆動素子であり、その棒状の一端はベース１１の中心部に、他端は送波板１２の中心部にそれぞれ接着固定されている。ベース１１と送波板１２は、それぞれ円板形状で、その周辺部には、表面に潤滑材を形成した４個の軸受け１３が、駆動素子１を囲むように、均等な角度間隔でそれぞれ挿入される。そしてベース１１の４箇所の各軸受け１３と、送波板１２の対応位置にある４箇所の各軸受け１３には、それぞれ軸棒１４をとおして全体を構成している。

【０００４】図３のように構成された送波器で、駆動素子１が図示されないソレノイドコイル（例えば丸棒状駆動素子１の周りを囲むように設けられる）により励振されると、駆動素子１は丸棒形状の長さ方向に伸縮するので、ベース１１の位置が図示されない容器等に固定されると、前記伸縮運動により送波板１２が駆動され送波器として動作する。

【０００５】

【発明が解決しようとする課題】しかしながら、図３に示す従来の超磁歪材を駆動素子とする送波器の構造では次のような問題があった。

（１）超磁歪材によりなる駆動素子のスムースな伸縮を阻害しないように、各軸受けと軸棒間に一定のクリアランス（間隔）を保持する必要がある。

（２）４本の軸棒は互に平行位置にある必要があり、この４本の軸棒の平行位置がずれると、駆動素子は軸棒に沿ってスムースな動きができなくなる。従って構成部品の合せ加工や精密加工が必要で、コスト高になっていた。

（３）例えば水圧等により棒状の駆動素子を曲げるような外力を受けた場合、軸受けと軸棒間のクリアランスが広過ぎると、軸受が印加外力を受ける前に、駆動素子がひずみにより破断する恐れがあった。

【０００６】

【課題を解決するための手段】本発明に係る超磁歪材料を用いた音響送受波器は、棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器において、前記板状ベースの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置にスライドベアリングをそれぞれ固定し、前記板状ベースに固定された各スライドベアリングと送波板の対応位置に固定された各スライドベアリングの間を摺動係合するスライドシャフトをそれぞれ設け、該各スライドシャフトの摺動軸が互に平行になるように構成したものである。

【０００７】本発明に係る超磁歪材を用いた音響送受器の製造方法は、棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器の製造方法において、予め１本のスライドシャフトに１対のスライドベアリングが同一摺動軸で摺動係合する摺動機構を少くとも２個用意しておき、前記板状ベースの接着固定面と送波板の接着固定面とを接触させた状態で、板状ベー

スの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置に前記各摺動機構の１対のスライドベアリングの一方と他方をそれぞれ固定し、次に前記各摺動機構の摺動動作を確認しながら板状ベースと送波板の間隔を広げて前記駆動素子の一端を板状ベースの中心部に、他端を送波板の中心部にそれぞれ接着固定するものである。

【０００８】

【発明の実施の形態】図１は本発明の実施形態に係る超磁歪材を用いた音響送受波器の構造図であり、図の（ａ）は側面断面図、（ｂ）正面断面図である。図１において、１は希土類合金等の超磁歪材によりなる丸棒形状の駆動素子であり、その棒状の一端はベース２の中心部に、他端は送受板３の中心部にそれぞれ接着固定されている。ベース２と送波板３は、ここではそれぞれ方形平面板の形状で、前記駆動素子１の接着固定面と直角な上側端面及び下側端面にそれぞれスライドベアリング４が取付けられボルト５により固定される。

【０００９】そしてベース２の上側端面及び下側端面にそれぞれ固定された各スライドベアリング４と送波板３の対応する上側端面及び下側端面にそれぞれ固定された各スライドベアリング４の間を摺動係合するスライドシャフト６をそれぞれ取付け、この２本の各スライドシャフト６の摺動軸が互に平行になるように構成する。なおスライドシャフト６と１対のスライドベアリング４よりなる摺動機構は、スライドシャフト６を曲げるような外力を受けても、発生するひずみ量は微少であるような材料、構造を用いている。

【００１０】図１のように構成した音響送受波器で、駆動素子１が図示されないソレノイドコイル（例えば丸棒状駆動素子１の周りを囲むように設けられる）により励振されると、駆動素子１は丸棒形状の長さ方向に伸縮するので、ベース２の位置が図示されない容器等に固定されると、前記伸縮運動により送波板３が駆動され送波器として動作する。また受波器としては、送波板３が外部からの入力音波により振動すると、駆動素子１が伸縮し、図示されない検出コイル（例えば丸棒状駆動素子１の周りを囲むように設けられる）に誘起電圧を発生し、受波器として動作する。

【００１１】図１の音響送受波器を、例えば水中音源として使用する場合等に、水圧等で棒状の駆動素子１を曲げるような外力をベース２と送波板３が受けることがある。この場合に、外力は、まずベース２と送波板３に直接固定されている駆動素子１に伝達され、次にスライドベアリング４に摺動係合している１対のスライドシャフト６に伝達され、それぞれひずみを生じる。最初に駆動素子１が伝達外力により曲がり出すが、破断にいたる前に次のスライドシャフト６が伝達外力を受ける。しかしスライドシャフト６の発生ひずみ量は小さいので、駆動素子１は一定量以上は曲がらず、破断することはない。

【００１２】以上のように本実施形態の送受波器によれば、１本のスライドシャフトに１対のスライドベアリングが同一摺動軸で摺動係合する摺動機構を２組用いて、棒状形状の超磁歪材よりなる駆動素子への曲げ外力を防止する構造としたので、次の効果がある。

（１）超磁歪素子が曲げ外力を受けても、破断応力に達する前にスライドシャフトが外力を受けるので、超磁歪素子は破断しない。

（２）送波板の送波方向には、摺動機構がスムースに動くため、送波器としての性能は低下しない。また同様に受波器としても、性能低下することなく動作する。

【００１３】図２は図１の音響送受波器の製造方法の説明図であり、図の（ａ），（ｂ），（ｃ）の順に製造を行う。また図の（ａ）～（ｃ）の左側の図は側面断面図、右側の図は正面断面図である。予めベース２と送波板３を精密加工する。特にベース２と送波器３は、駆動素子１との接着面を基準として、この接着基準面と直角な上側端面及び下側端面、即ちスライドベアリング４の取付面の直角度を精密に加工する。また、スライドベアリング４とスライドシャフト６間のクリアランス（間隔）は、ほぼ０．０１㎜に加工する。

【００１４】製造手順は、予め、１本のスライドシャフト６に１対のスライドベアリング４が同一摺動軸で摺動係合する摺動機構を２組用意しておく。そしてまず、図２の（ａ）に示すように、ベース２と送波板３の駆動素子１との接着面側を接触させた状態で、ベース２の上側と下側の端面（スライドベアリング取付面）及び送波板３の上側と下側の端面（スライドベアリング取付面）に前記用意した各摺動機構の１対のスライドベアリング４の一方と他方をそれぞれボルト５で固定し、スライドシャフト６がスムースに動くことを確認する。

【００１５】次に、前記各摺動機構の摺動動作を確認しながら、図２の（ｂ）に示すように、ベース２と送波板３の間隔を駆動素子１を接着できる程度に広げて、棒状駆動素子１の一端はベース２の接着面に、他端は送波板３の接着面にそれぞれ接着する（図２の（ｃ）を参照）。

【００１６】以上のように本実施形態の送受波器の製造方法によれば、予め１本のスライドシャフトに１対のスライドベアリングを摺動係合させた摺動機構を少くとも２組用意しておき、ベース及び送波板の駆動素子との接着面の平行度と摺動機構のスムーズな摺動動作とを確認しながら組み立るので、組立工程の手戻りを防止でき、製造効率を向上させることができる。

【００１７】なお、本実施形態では、１本のスライドシャフトに１対のスライドベアリングを摺動係合させた摺動機構を２組用いる例を示したが、本発明はこの２組に限定されるものではなく、例えば４組用いて、図１のベース２と送波板３の上下左右の各端面にそれぞれスライドベアリングを取付けるようにしてもよい。

【００１８】

【発明の効果】以上のように本発明によれば、棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器において、前記板状ベースの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置にスライドベアリングをそれぞれ固定し、前記板状ベースに固定された各スライドベアリングと送波板の対応位置に固定された各スライドベアリングの間を摺動係合するスライドシャフトをそれぞれ設け、該各スライドシャフトの摺動軸が互に平行になるように構成したので、超磁歪材よりなる駆動素子が曲げ外力を受けても、破断応力に達する前に、スライドシャフトが外力を受けるので、駆動素子が破断することはない。また上記構成により送受波器の性能を低下させることもない。

【００１９】また以上のように本発明によれば、棒状の超磁歪材よりなる駆動素子の一端は板状ベースの中心部に、他端は送波板の中心部にそれぞれ接着固定されて構成される音響送受波器の製造方法において、予め１本のスライドシャフトに１対のスライドベアリングが同一摺動軸で摺動係合する摺動機構を少くとも２個用意しておき、前記板状ベースの接着固定面と送波板の接着固定面とを接触させた状態で、板状ベースの接着固定面と直角な端面及び送波板の接着固定面と直角な端面の互に対応する少くとも２箇所の各位置に前記各摺動機構の１対のスライドベアリングの一方と他方をそれぞれ固定し、次に前記各摺動機構の摺動動作を確認しながら板状ベースと送波板の間隔を広げて前記駆動素子の一端を板状ベースの中心部に、他端を送波板の中心部にそれぞれ接着固定するようにしたので、組立工程の手戻りを防止でき、製造効率を向上することができる。

【図面の簡単な説明】

【図１】本発明の実施形態に係る超磁歪材を用いた音響送受波器の構造図である。

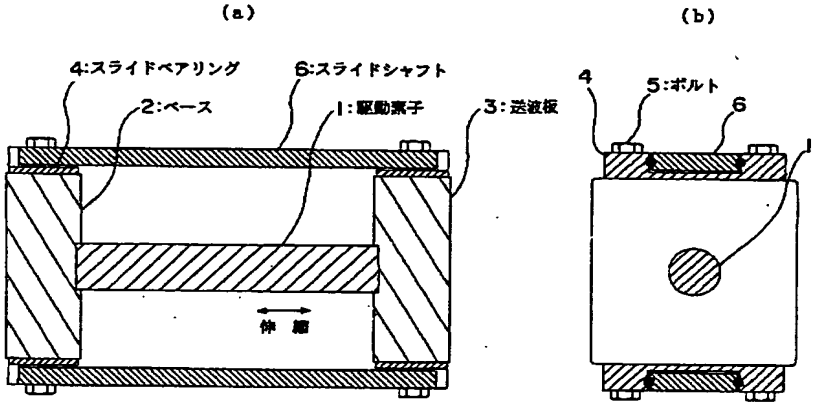
【図２】図１の音響送受波器の製造方法の説明図である。

【図３】従来の超磁歪材を駆動素子とする送波器の構造図である。

【符号の説明】

１　駆動素子
２，１１　ベース
３，１２　送波板
４　スライドベアリング
５　ボルト
６　スライドシャフト
１３　軸受け
１４　軸棒

【図１】



本発明の実施形態に係る超磁歪材を用いた音響送受波器の構造図

【図２】

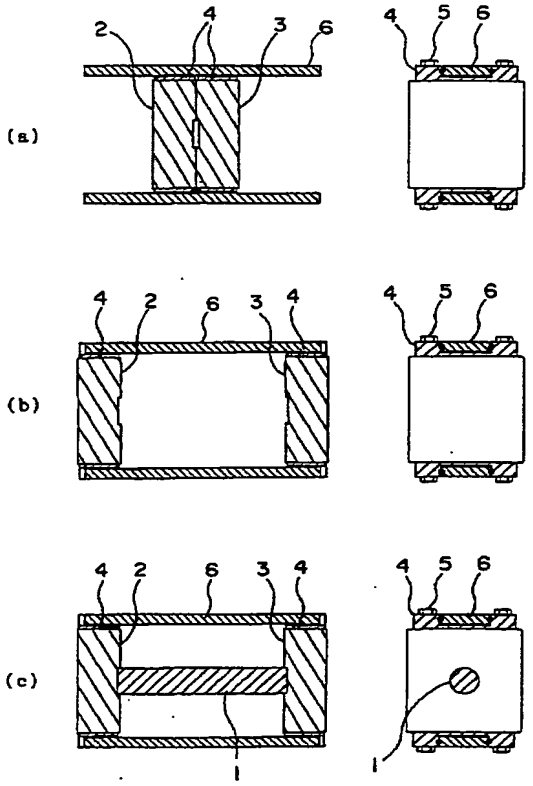
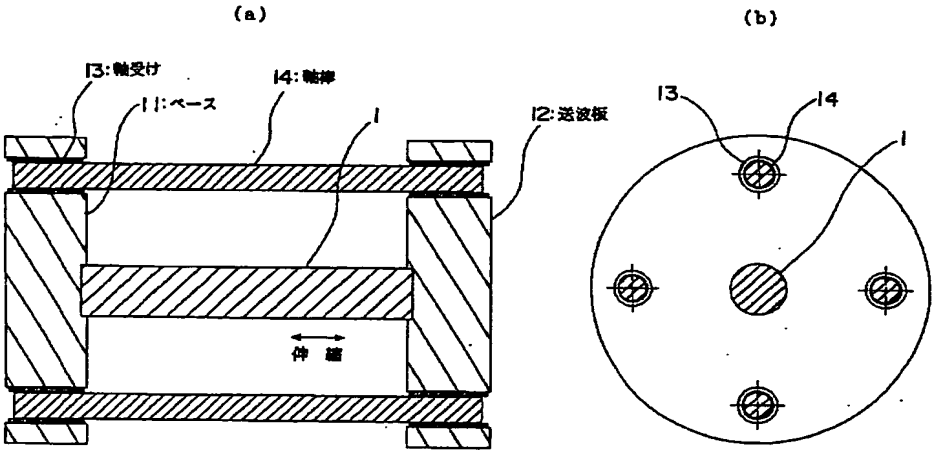


図１の音響送受波器の製造方法の説明図

【図３】



従来の超磁歪材を駆動素子とする送波器の構造例を示す図

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